

# COMMON MISSILE QUALITY FUNCTION DEPLOYMENT APPLICATIONS

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## Introduction

The Common Missile (CM) Project Office and its weapon system users (henceforth referred to in this article as “users”) are applying a tailored quality function deployment (QFD), which will ultimately result in a better product for the soldier. In particular, QFD is to be used to assist in establishing system measures of effectiveness (MOEs) and measures of performance (MOPs), and to assist in linking system requirements to specific MOEs and MOPs. Fundamentally, however, the principle driver behind the CM Project Office’s desire to apply a tailored QFD is to ensure that it has a firm understanding of the requirements in clear operational terms. QFD is an analytical technique to ensure the customer’s voice is strong during a system’s development. With roots in the commercial manufacturing sector, the QFD is being used increasingly in the acquisition community and is proving to be extremely effective.

The CM Project Office was chartered in 2001 to develop and field anti-armor missiles suitable for use on both ground and air platforms. CM is the primary new weapon system for the Comanche and is a candidate lethality system for the Future Combat Systems. CM has the ability to mitigate the risk created by the aging stockpile of Army, Navy, and Marine Corps Tube-launched, Optically-tracked, Wire-guided (TOW) and HELLFIRE missile systems while enabling the Army transformation to the Objective Force. With the signing of a Memorandum of Understanding in December 2001, CM became an international cooperative program with the United Kingdom and has attracted interest from sister Services as a joint program. This large and diverse user base demands that the materiel developer clearly understand not only the

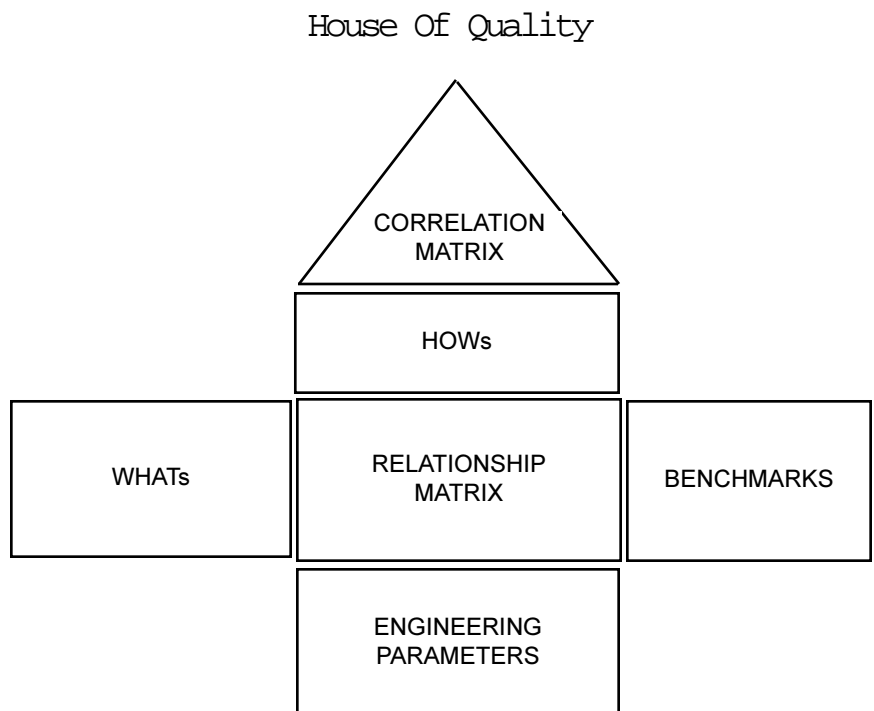
system’s requirements but, perhaps more importantly, the operational intent behind each specific requirement.

As is the case with most analytical tools, the process often provides more value than the product; this is certainly the case within the CM Program. Through a series of materiel developer and user meetings, the CM Project Office was able to quickly grasp the intent behind the requirements while also gaining an understanding of each user’s unique operational environment and likely target set. The resulting product of this tailored QFD application includes a prioritized list of relevant MOEs and MOPs, MOE and MOP definitions, and a correlation matrix that ties each requirement to the MOE or

MOP that it addresses. This information is being linked to the CM Simulation Support Plan, the Test and Evaluation Master Plan (TEMP), and the CM performance specification to assist in establishing traceability among the documentation that will be used to develop, test, and field the CM.

## Background

QFD is a systematic process for ensuring that a developer establishes and maintains a user focus. Cross-functional teams use QFD to identify and resolve issues involved in providing products, processes, services, and strategies that will more than satisfy customers. A prerequisite to QFD is research to determine each user’s needs, rationale, and intended applications.



This is the process of understanding what the customer wants and how important these benefits are.

The use of QFD can help identify design objectives that reflect user needs. Identifying design objectives from a user's point of view ensures that each user's interests and values are created in the phases of the product innovation process. It can also promote an evolutionary approach to product innovation by carefully evaluating product performance from operational and user perspectives.

## Objectives

The primary objectives of QFD are to keep a customer focus, reduce the product development cycle, establish product development specifications—requirements capture, and increase customer satisfaction.

Traditional commercial applications of QFD provide a means of analysis that allows the manufacturer to better understand the user's needs. Applying QFD techniques allows manufacturers to bring innovative products to market more efficiently—in terms of cost, schedule, and risk. QFD attempts to cut down the number of discrepancies in understanding between developer and the end user by linking each “what” to a series of increasingly detailed matrices, commonly referred to as “how.” This is accomplished by populating a table often referred to as the “house of quality” (see figure). This house of quality links the whats to the hows by having customers complete a “relationship matrix” to identify which design solutions (hows) are intended to satisfy each customer need (whats). Completing the relationship matrix includes evaluating how strongly each of the design solutions are related to each customer need.

Additional information provided by the house of quality includes a means to link specific engineering parameters to customer needs as well as a means to benchmark competitor or conceptual solutions to customer needs.

## CM-Tailored Application

The CM Project Office and its users tailored the traditional QFD process to better suit their needs. This tailoring pri-

marily involved redefining the whats and the hows. The whats became the list of MOEs and MOPs. In operational terms, what do users want and how strongly do they want it? Examples of the whats include increasing “red losses,” decreasing “blue losses,” increasing missile range, and reducing launch signatures. The hows became each requirement provided in the Operational Requirements Document (ORD). Examples of the hows include range, lethality, platform integration, and environmental requirements.

After developing the list of applicable MOEs and MOPs, each CM user identified which requirements were developed to address each MOE and MOP. This was done in a matrix form for ease of use. In addition to linking MOEs and MOPs to requirements, each user was asked how strongly (strong, medium, and weak) each requirement is related to its MOEs and MOPs.

## Applications And Benefits

The products resulting from the CM QFD effort are considered to be “living” and will be modified as user needs evolve and operational priorities change. The process followed to develop the requirements-MOE/MOP relationship provided both the project office and its users with a detailed understanding of the relationship between battlefield effectiveness (MOE/MOP) and system requirements (ORD). This understanding enhances the CM Project Office's ability to translate operational requirements into the system performance specification. As this information matures and couples with a rigorous systems engineering environment, it will allow CM stakeholders to more rapidly accommodate change and better answer user needs. In addition to an opportunity for the CM Project Office to engage its users in a series of meaningful discussions, the benefits include MOE and MOP definitions for use in the TEMP, the Simulation Support Plan, and the system's Analysis of Alternatives.

## Conclusion

The technical and operational challenges associated with developing a missile system intended for use on legacy and future ground platforms,

rotary-wing platforms, and fixed-wing platforms are significant. The CM Project Office and its users recognize these challenges and realize that engaging in a modified form of QFD provides the detailed information, within an operational context, necessary to ensure that the materiel developer has an in-depth understanding of each requirement. Modifying the traditional house of quality to better suit the needs of DOD's acquisition community provides for a more meaningful product while allowing the information to flow into numerous plans, analyses, and documents necessary to develop, test, field, and support the CM. To date, the most valuable result is the series of materiel developer-user meetings necessary to complete the QFD process. Early in the system's development cycle, these meetings have provided CM stakeholders an opportunity to engage in detailed and meaningful discussions regarding requirements and, perhaps more importantly, how the missile will be used to improve the force's battlefield effectiveness.

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